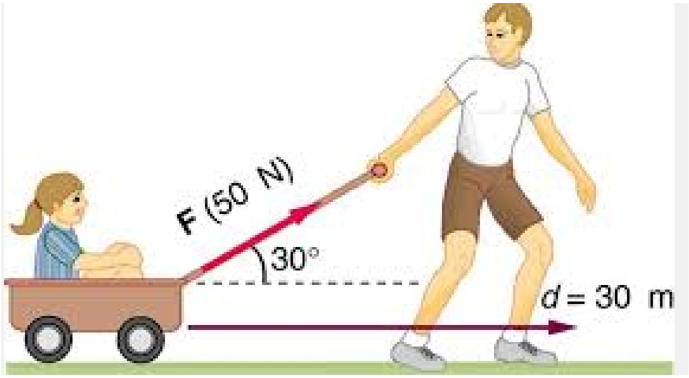
VECTORS – LAB – Name ________________ prepared by Dr. V. Lankar

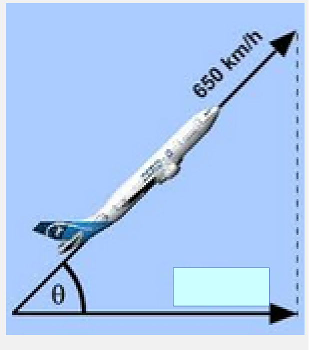
A vector represents a physical quantity that has both magnitude and direction
The vector shows: how much, of what, which way

Examples of physical quantities that are vectors:

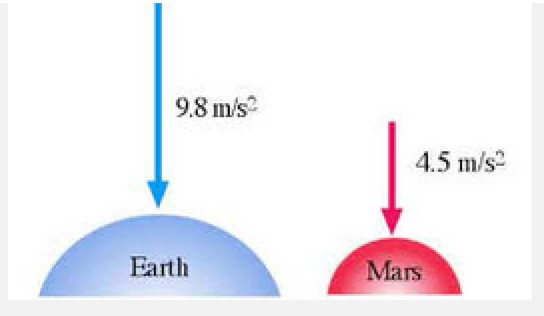
Force. You are pulling a cart with a force of **50 newtons @ 30 degrees**.
50 newtons is about 10 pounds



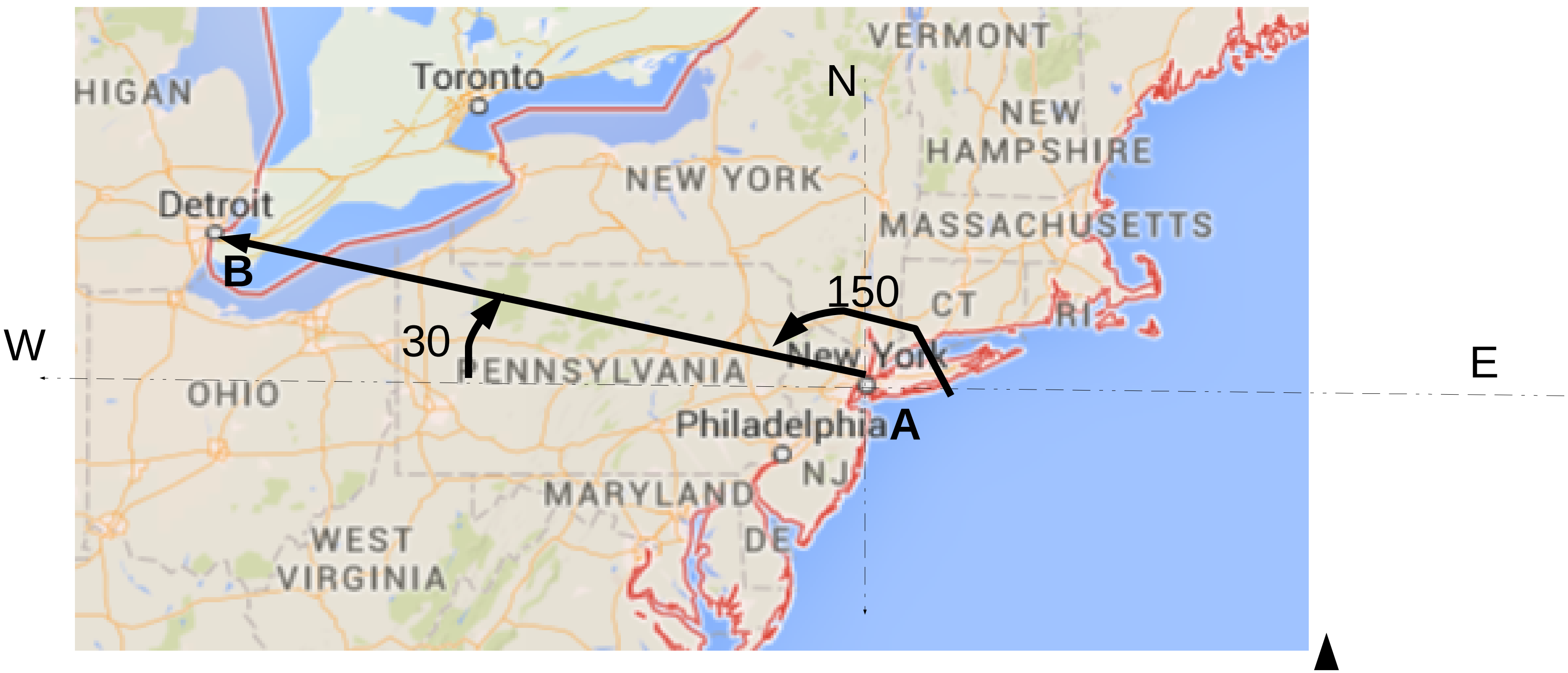
displacement. While pulling you move the car **30 meters @ right.**
30m@ right is a vector displacement.



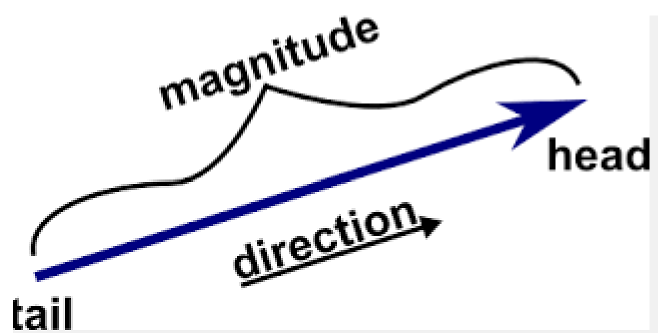
velocity. The airplane is taking off with a velocity of 650km/s@ 45
Its speed is 650km/s and its direction is 45 degrees (theta).
Velocity is a vector = **650km/s @ 45**
Speed is a scalar. It has no direction.



acceleration. If an object speeds up, slows down or change direction there
Is a change in its velocity. The rate of change is the acceleration.
An object in free-fall has an acceleration = **22mph/s @ down** no Earth
So every second, it goes 22mph/s faster.
Or acceleration =9.8m/s/s @ down. 9.8m/s = 22mph

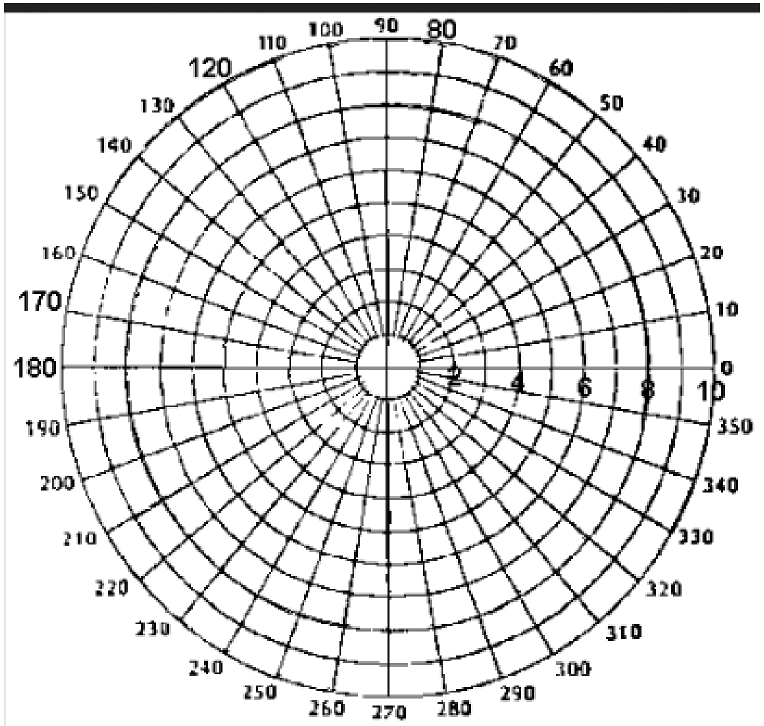


AB is a vector displacement
A is the head and B the tail.
The magnitude is 600 miles
The direction is 30 degrees N of W



Notations:

600 miles@30 N of W
600 miles @ 150



Unit circle – the radius is one -
The direction is counterclockwise (ccw)
Angles are measured in degrees or radians
180 degrees = 1 Π radians = (3.14 .. radians)

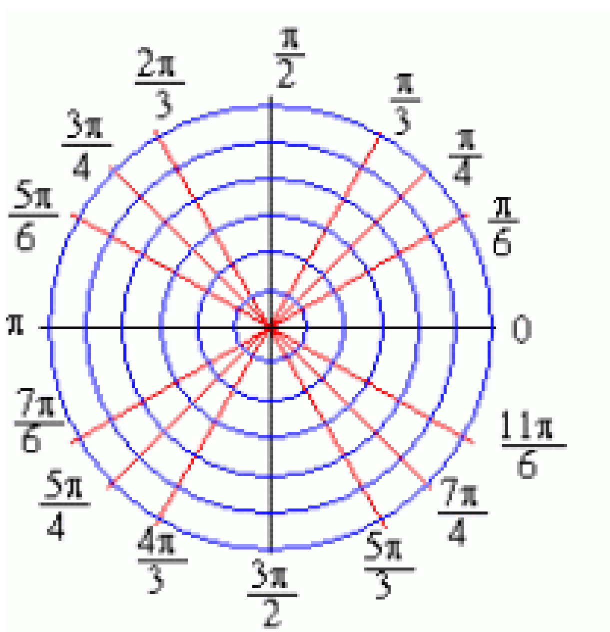
Examples:

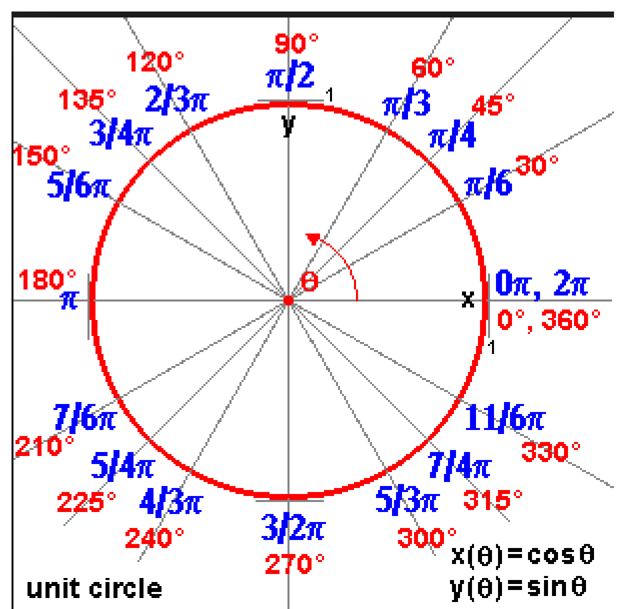
54 degrees in radians ? = 54 x Π / 180

6 radians in degrees ? = 6 x 180 / Π

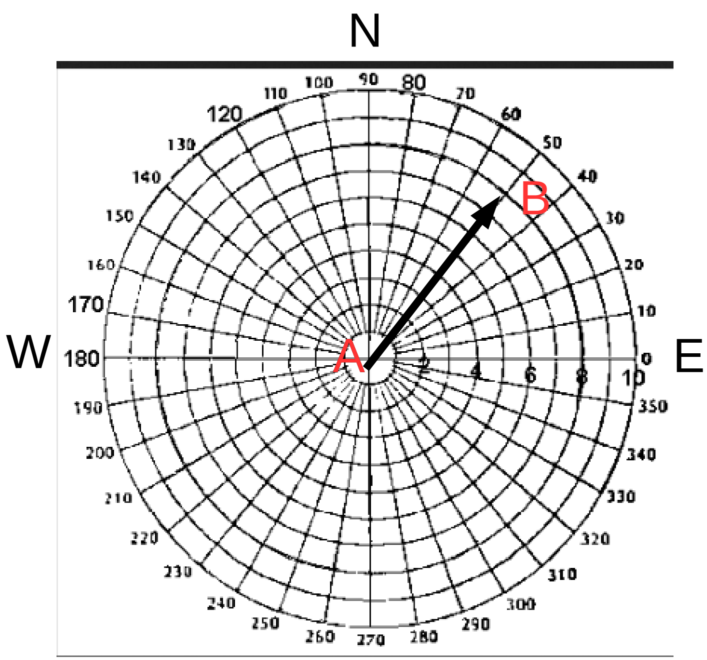
Π/3 in degrees ? =180/3 = 60 degrees

Π is 3.14159...





Polar notation for vectors:

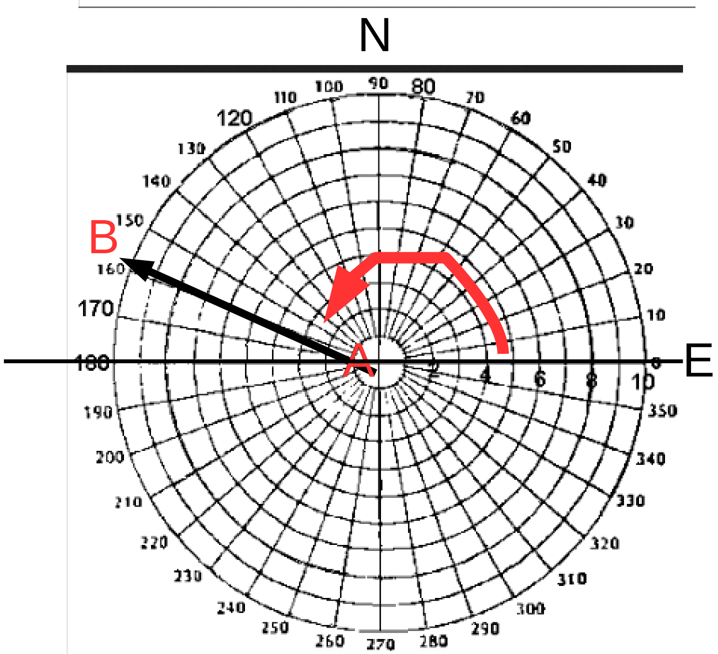


We can use several notations. Le'ts call this vector AB . AB is a vector displacement.
A object could have been moved from A to B by a distance of 8 feet in the direction
Shown. Here are the notations :

AB= 8 feet @ 50 N of E or

In standard notation (used in Physics) **just AB = 8ft @ 50**
Also called the polar notation.

A vector has a magnitude (8ft) and a direction (50).
It shows how much (8) , of what (ft), which way (50).



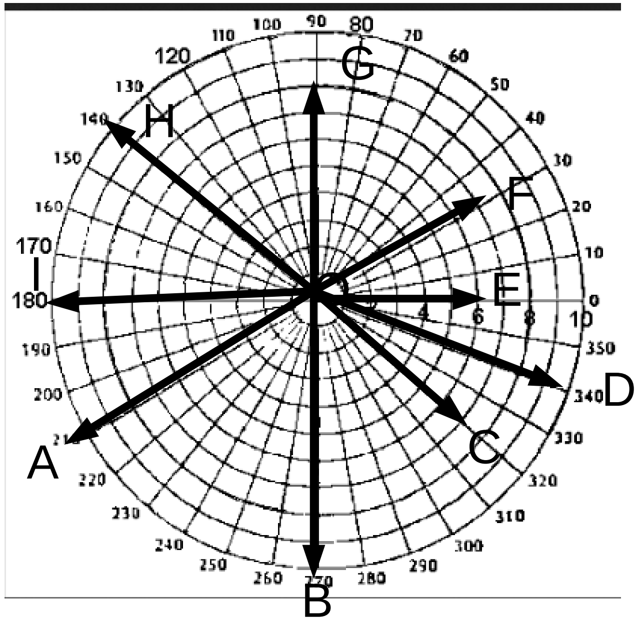
AB = 10 ft @ 160   in standard notation or

AB = 10ft @ 20 N of W

We don't write 70 W of N because we want an angle smaller than 45

Magnitude is 10 feet.

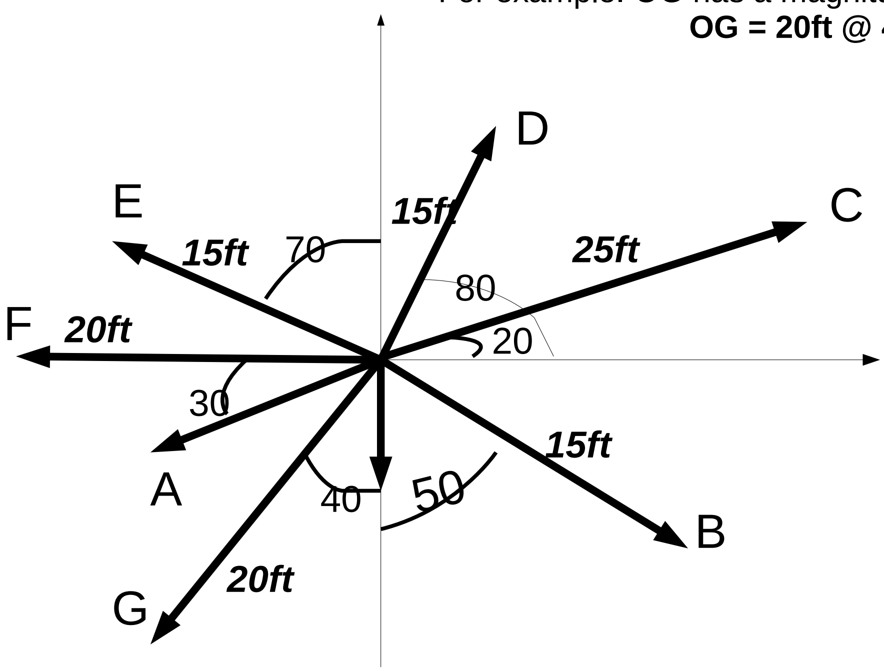
So in standard notation the angle is always between 0 and 360.
We always go counter clockwise



Use 2 notations for each of those vectors:

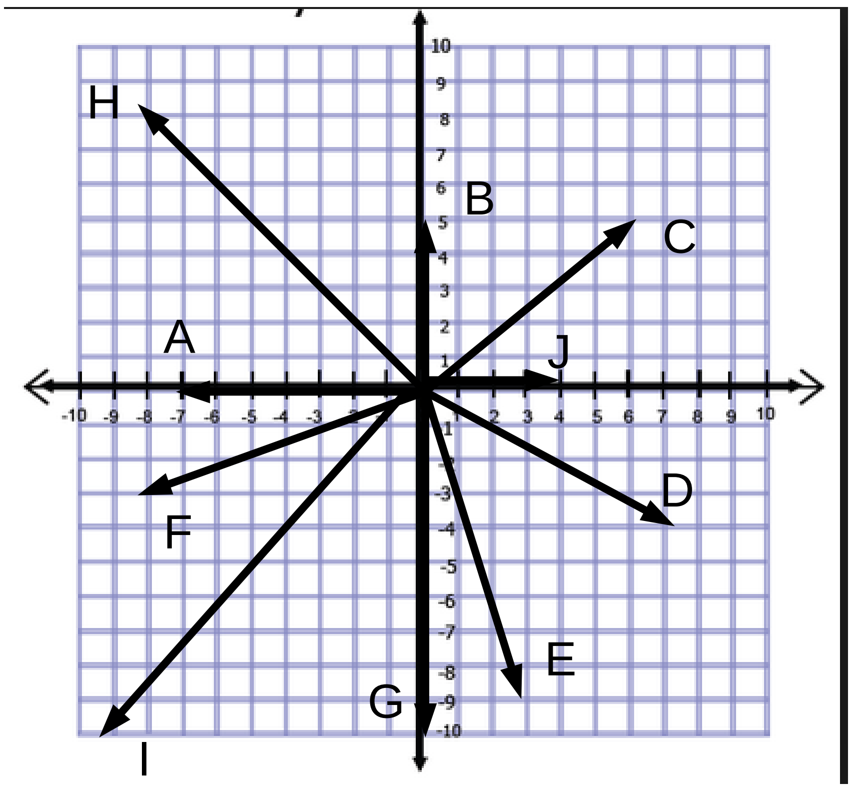
Standard notation (Physics)	**orientation notation**
OD = 10 ft @ 340	**OD= 10ft@ 20 S of E or OD= 10ft @ -20**
OA=	**OA=**
OB=	**OB=**
OC=	**OC=**
OE=	**OE=**
OF=	**OF=**
OI=	**OI=**

Now you should be able to do the same thing without the trigonometric circle.
For example. OG has a magnitude of 20 ft.
OG = 20ft @ 40W od S (or 40 from S toward W) or OG = 20ft @ 230



OA=	or OA=
OB= 15 @50E of S	or OB= 15@320
OC=	or OC=
OD=15@ 10 E of N	or OD= 15@80
OE=	or OE =
OF=	or OF =
OG=	or OG =

Vectors can also be described by their components instead by their magnitude and direction.



OD has components (7,-4) We write OD(7,-4)

OA (,) OH (,)

OB (,) OI(,)

OC (,) OJ (,)

OE (,)

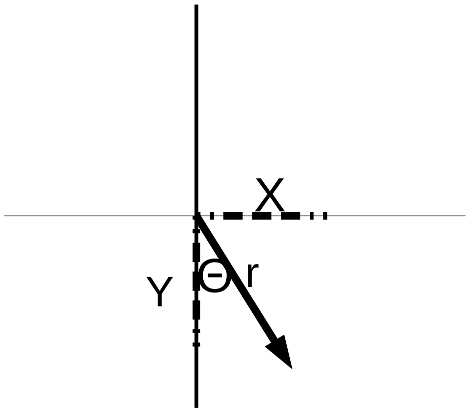
OG (0 , -10)

If you have the components then you can find the magnitude using Pythagorean theorem and tangent.
You are going from the component notation to the polar notation. The tricky part is to identify first the angle you are solving for. The magnitude is easy.

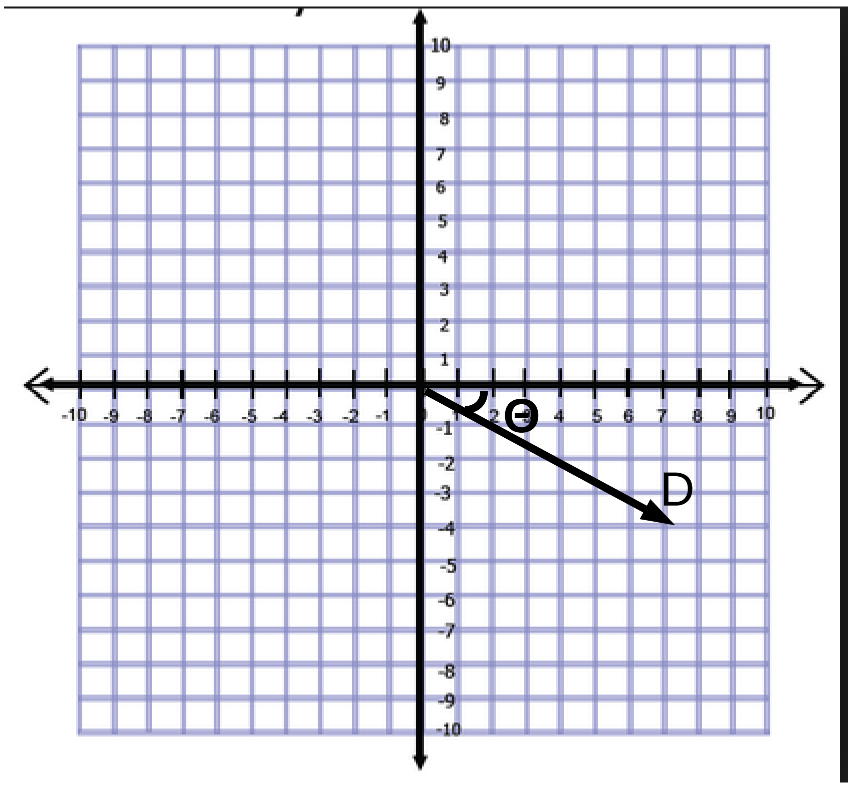
$r=\sqrt{x^2+y^2}$

tan(Θ)=X/Y

Θ is smaller than 45



Going from component notation to polar notation



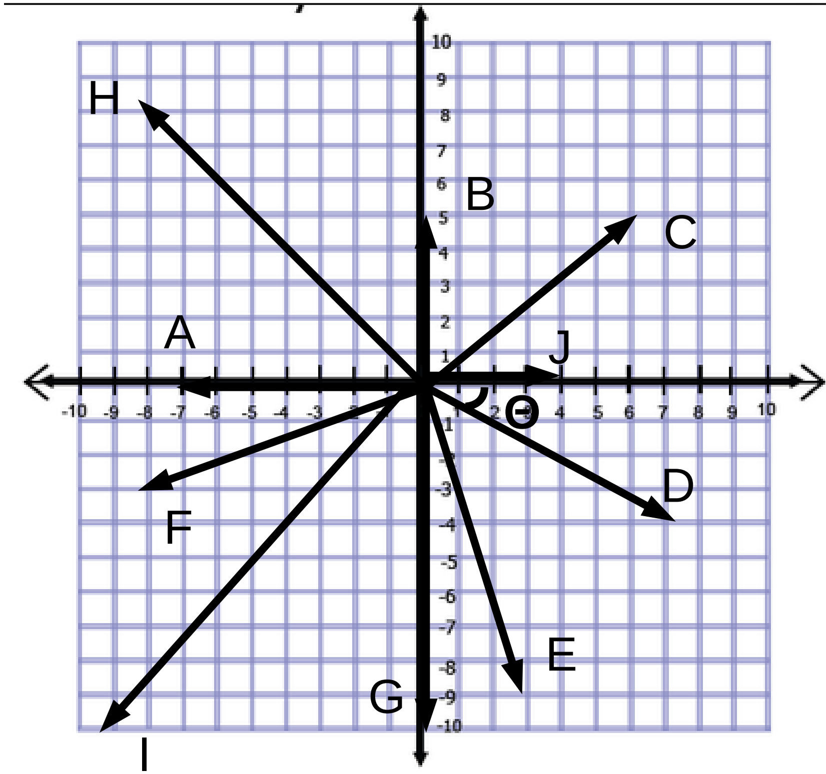
For example OD has components (7,-4)
So x=7 and y = -4
1) First write on the graph the angle Θ you are working
With. You have 2 angles to work with.
The angle between the vector and the x-axis or
The angle between the vector and the the y-axis.
I picked the x-axis because it is the smallest.

2) then use Pythagorean theorem to find **OD** the
Magnitude (length). Ignore negative signs.
OD = $\sqrt{(4^2 + 7^2)} = \sqrt{65} = 8.1$ ft

3) find the angle (look at the graph) using
tan(Θ) = opposite / adjacent. Ignore negative sign.
tan(Θ) = 4/7 . You are not always using y/x
It depends where Θ is. Y/x works for the angle with x-axis
Use tan(Θ) = opposite/adjacent.
Solve for Θ = 30 about (29.7 degrees)
Make sure the mode is in degrees and not
Radians.
4) write the notation **OD=8ft @ 30 S of E**
Or **OD= 8 ft @ 330** or **OD = 8ft @ -30**

You can use a negative angle only if the vectors
Is in the last quadrant.

Going from component notation to polar notation



Convert the components notation to polar coordinates
See previous page.

OA (-7,0) = 7 @ 180

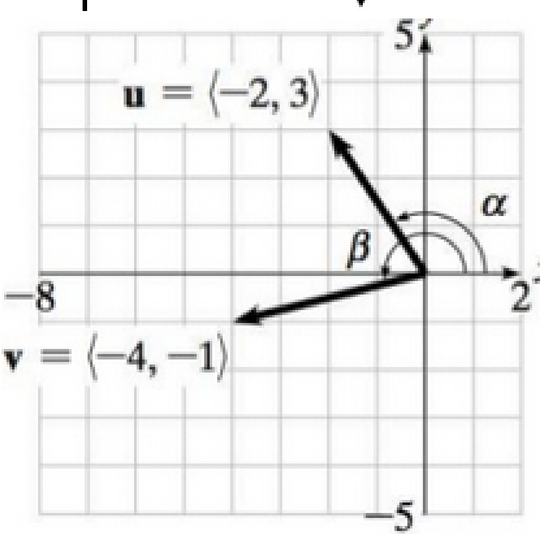
OD(7,-4)=8@330 or 8@-30 (use negative angles only for the last quadrant)

OG(0,-10)=

OB (,) =

OH (,)=

OC (,)=



U (-2,3)=

V(,) =4@194

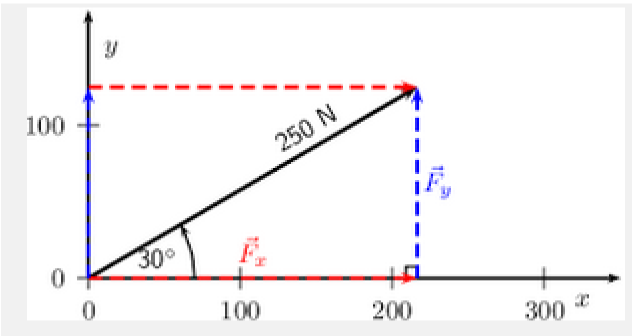
OE (,) =

OI (,)=

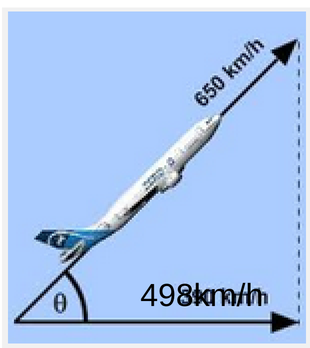
OF (-8 , -3) = 8.5@200

OJ (,)=

Going from polar notation to component notation



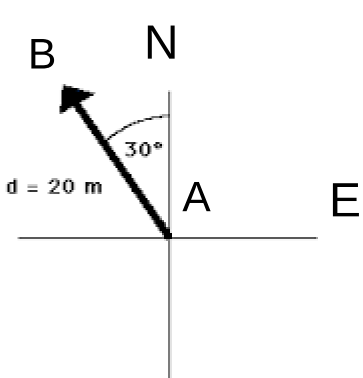
If a force of 250N is applied in a direction of 30 degrees N of E
Then force **F = 250N @ 30**
You can find the component Fx anf Fy.
Fx is how much the object was pulled along the x-axis
And Fy how much the object was pulled along the y-axis
Fx= 250 cos(30) = 216.5N and Fy=125N
So F = 250N @ 30 and F (216.5, 125)



The airplane has a velocity of 650mph and takes off at an angle of 40 degrees.
V=650km/h @ 40. How fast is it going @ east (horizontally) ? (find Vx)
How is is going upward ? (find Vy)

Vx=

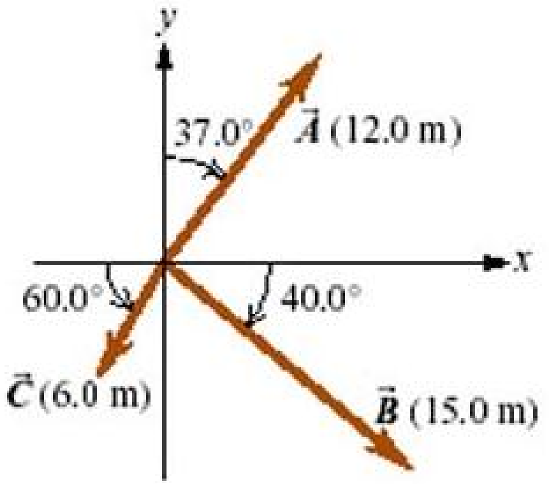
Vy=



You are moving from A to B. **AB = 20 meters @ 30 W of N**
How far did you move in the west direction ? (X-component <0)
How far did you move in the Est direction ? (Y-component)

ABX = -

ABY =

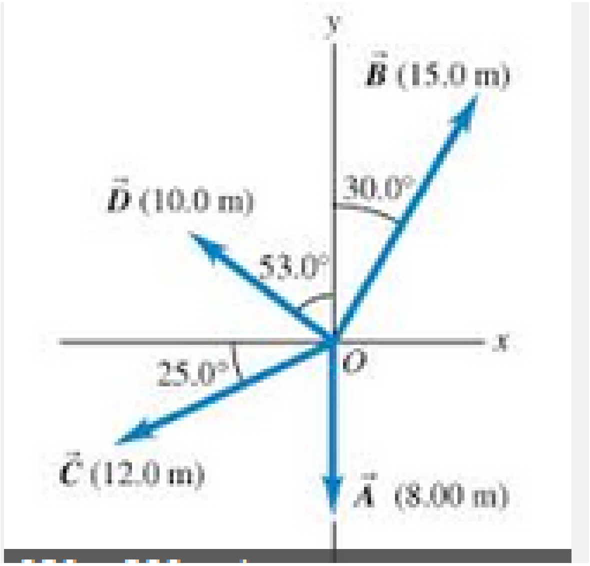


Use cosine and sine to find the components of A, B, C
!! pay attention to the sign of the component. Make sure that a vector Pointing left or down has a negative sign in front.

Ax = Ay =

Bx = By= -

Cx = -6cos(60)=-3m Cy= - 6sin(60)=-5.2m



Make sure that a vector pointing left or down has a negative sign in front.

Ax = Ay =

Bx = By=

Cx = Cy=

Dx= Dy=